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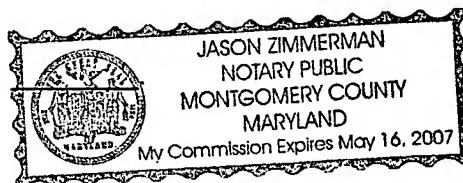
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By: Kathy Borin, Project Coordinator

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## SPECIFICATION

### 1. Title of the Invention

Bonding Process for Silicon Carbide Compacts

### 2. Claims

- (1) A bonding process for silicon carbide compacts (moldings) characterized in that, for a process to bond silicon carbide compacts by reaction sintering after fitting one of the silicon carbide compacts formed of silicon carbide grains with mutually different particle sizes into the other paring compact, the fitting surfaces between said both silicon carbide compacts are respectively formed into tapered shape having the same specified angle against the fitting direction.
- (2) The bonding process for silicon carbide compacts as set forth in Claim 1 wherein, after applying the binder formed of silicon carbide and resin onto the fitting surfaces between said both silicon carbide compacts, the reaction sintering is performed.
- (3) The bonding process for silicon carbide compacts as set forth in Claim 1 wherein said taper angle is 5 to 85°.
- (4) The bonding process for silicon carbide compacts as set forth in Claim 2 wherein said resin is furan resin.

### 3. Detailed Description of the Invention

#### [Industrial Field of Application]

The present invention relates to a bonding process for silicon carbide compacts, and particularly to the bonding process for silicon carbide compacts that is suitably applied for obtaining products each having portions mutually different in porosity in the same single

body, such as an electrode for semiconductor etching unit, through carrying out the bonding between the silicon carbide compacts formed of silicon carbide grains with mutually different particle sizes by using the reaction sintering treatment.

[Prior Art]

Conventionally, the process for bonding silicon carbide compacts formed of silicon carbide grains with mutually different particle sizes by reaction sintering has been carried out as shown in Figure 5.

In this process, a discoid member 51 that is a silicon carbide compact having a circular hole 51a at its center and a small discoid member 52 whose shape is corresponding to that of circular hole 51a are formed, and the bonding surfaces of both members 51, 52, that is, the peripheral side surface of the circular hole 51a formed in the discoid member 51 and the outer peripheral side surface of the small discoid member 52 are formed into the planes parallel to the bonding direction, respectively, with the binder formed of a mixture of silicon carbide and furan resin applied to the respective bonding surfaces.

Then, after performing the primary adhesion by fitting said small discoid member 52 into the circular hole 51a formed in said discoid member 51, both members 51, 52 are bonded by turning the molten silicon into silicon carbide by causing the former to react with the binder through reaction sintering.

[Problem Intended to Be Solved by the Invention]

However, in the conventional bonding process described above, gaps, such as pores, tend to be readily formed in the bonding surfaces of both members 51, 52, thereby posing the problem of making it difficult to form an integral disc that is free of pores.

The object of the present invention is, by solving the foregoing problem in prior art, to provide the bonding process for silicon carbide compacts, that is capable of preventing the formation of gaps, such as pores, in the bonding surfaces when bonding the silicon carbide compacts formed of silicon carbide grains having mutually different particle sizes.

[Means of Solving the Problem]

The foregoing object is achieved by, when bonding the silicon carbide compacts through reaction sintering after press-fitting one of the silicon carbide compacts formed of the silicon carbide grains with mutually different particle sizes into the other paring compact, forming the fitting surfaces between the above-mentioned silicon carbide compacts into tapered shape having the same specified angle against the fitting direction, respectively.

[Operation of the Invention]

In the present invention, through use of the means described above, the following is achieved. That is, when press-fitting one of the silicon carbide compacts formed of silicon carbide grains with mutually different particle sizes into the other paring compact, as the fitting surfaces of both compacts are formed into tapered shape having the same specified angle against the fitting direction, the fitting surfaces come to evenly adhere to each other even after reaction sintering, with no gap formed. Also, when the binder formed of silicon carbide and resin is applied to the respective fitting surfaces, during the reaction sintering, by the reaction between molten silicon and carbon, a dense bonding layer is formed by the generation of silicon carbide along the fitting surfaces.

[Embodiment]

Hereunder, the description of the embodiment of this invention will be provided with reference to the drawings.

Figure 1 is an illustration showing an embodiment of the bonding process for silicon carbide compacts according to this invention.

In Figure 1, in a discoid member 1 that is a compact formed of silicon carbide grains with a certain mean particle size, an inverted truncated cone shape hole 1a is formed at the center.

Also, a small discoid member 2, that is a compact formed of silicon carbide grains with mean particle size different from the above and that is to be fit in said hole 1a, is formed into the shape corresponding to the shape of hole 1a.

Furthermore, the wall surface of the hole 1a formed in the foregoing discoid member 1 and the circumferential side wall of the small discoid member 2 are, as shown in Figure 2, finished into tapered shape, respectively. As the angle X against the fitting direction of the members 1, 2, 5 to 85°, about 10° in particular, are preferable.

In the case where the foregoing angle X is smaller than 5°, there occurs a drawback of making it impossible to prevent the formation of gaps in the bonding portion, while, when the angle X is larger than 85°, the same drawback as above occurs.

Next, the binder is applied to the respective taper-finish surfaces of said discoid member 1 and small discoid member 2.

The binder in this case is prepared by using the mixture of silicon carbide of which both members 1, 2 are formed and the resin component that contains organic carbon, such as furan resin.

In the next step, the primary adhesion is performed by press-fitting the small discoid member 2 into the inverted truncated cone shape hole 1a bored in the above-mentioned discoid member 1.

(The bonding portions of) both members 1, 2 treated with primary adhesion as described above are turned into silicon carbide through the reaction between molten silicon and binder at the temperature exceeding the melting point of silicon (1414°C), and by causing the reaction sintering (in the portion) between both members 1, 2, the complete binding is achieved.

In the above-mentioned embodiment, an example wherein the small discoid member 2 is bonded to the discoid member 1 is demonstrated, but the present invention has no specific restriction as to the contour of the member 1, and any shape may be used as far as the essential conditions, that is, the hole or bore finished into tapered shape whereto the member 2 can be fit is provided in the member 1, while the member 2 is also finished into tapered shape having the same angle as that of the member 1 thereby enabling the tapered fitting surfaces to be bonded to each other, are met.

#### Embodiment -1

The discoid member 1 shown in Figure 1 was manufactured by using silicon carbide grains having the mean particle size of 1.5  $\mu$  m as the material, and the small discoid member 2 was manufactured by using silicon carbide grains having the mean particle size of 5  $\mu$  m as the material.

Then, the center of the foregoing discoid member 1 was hollowed out to create a hole having the inverted truncated cone shape of taper-finish with the angle X of  $11^\circ$ . Also, the small discoid member 2 was formed into inverted truncated cone shape with taper-finish having the angle X of  $11^\circ$ .

Next, after applying the binder formed of the mixture obtained by compounding the silicon carbide with furan resin at the ratio of 3 : 2 over the respective fitting surfaces of both members 1, 2, said small discoid member 2 was pushed into the hole 1a formed in the member 1 and the fitting was completed as shown in Figure 3. Thereafter, the members 1, 2 were treated with reaction sintering at  $1500^\circ\text{C}$ .

As a result, the fitting surfaces of both members 1, 2 came to have the state as shown in Figure 4.

That is, in Figure 4, 3 denotes the silicon carbide (large in particle size), 4 indicates the silicon carbide (small in particle size), and 5 represents the silicon. Thus, it was confirmed that the bonding was achieved completely with no gaps formed in the fitting surfaces of both members 1, 2.

#### [Effects of the Invention]

As has been described above, according to the present invention, excellent effects are obtained. That is, the bonding surfaces of silicon carbide compacts after fitting those silicon carbide compacts formed of silicon carbide grains with mutually different particle sizes to each other and treating those surfaces with reaction sintering are virtually free of gaps caused to them. Also, the product obtained after reaction sintering has portions respectively different in porosity without any gaps formed in the bonding portion, thereby getting provided with superior integrity.

#### 4. Brief Description of Drawings

Figure 1 illustrates an embodiment of the method for bonding the silicon carbide compacts to each other. Figure 2 is an explanation drawing showing the taper-finish surfaces according to the present invention. Figure 3 is a sectional view of the state of fitting between silicon carbide compacts in the present invention. Figure 4 is an enlarged sectional view of the portion A in Figure 3. Figure 5 is an illustration showing the conventional method for bonding the silicon carbide compacts to each other.

- 1 ... .. Discoid member
- 1a ... .. Hole
- 2 ... .. Small discoid member
- 3 ... .. Silicon carbide (large in particle size)
- 4 ... .. Silicon carbide (small in particle size)
- 5 ... .. Silicon

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/For figures 1, 2, 3, 4, 5, refer to the Japanese text/